

## Literature Review on Variable Frequency Drive

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**Abstract**—A Variable frequency drive (VFD) is the type of motor controller that drives an electric motor by varying the frequency and voltage supplied to electric motor. The AC input given to VFD is used to drive induction motor. Rectifier diode is used for rectification of AC output & filter capacitor is used to reduce the ripples in output DC supply. The inverter circuit drives the IGBT to invert DC to AC as per inverter frequency to AC induction motor input. Microcontroller is used to control/monitor/set the output frequency and current of the AC induction motor.

**Key words:** V/F Control Technique, Variable Frequency Drive

### I. INTRODUCTION

In this modern era of industries, most of the processes need speed control or variable speed for precise results. Traditionally, for the speed variations, DC machines were used as their speed can be changed by changing input voltage level. But this is not the case in Induction motors, Infact, change in input voltage may damage these motors. But the advantages of Induction motors like simple and strong construction and the requirement of driving and controlling their speed resulted in development of advanced motor drive technique. One such technique is the use of VFD.

The recent upsurge in the use of VFD is due to the fact that along with providing variable speed for Induction motor, it also helps in making the system energy efficient. Energy is significantly saved during lower speed operation of the motor. VFD also improves dynamic as well as steady state characteristics of the motor.

### II. LITERATURE SURVEY

Few papers are presented here in form of review from various literatures we studied. In [1] Pooja S.Billade and Sanjay S.Chopade have proposed cheaper and power efficient wireless speed control of the motor. They used GSM Technique for long distance transmission of reading using PIC16F7X7 microcontroller. The control principle of constant V/Hz is discussed in which supply frequency as well as supply voltage can be varied keeping voltage to frequency ratio constant. In [2] Bhatt and Hajari have used VFD for flow control of fluid in industries. In this paper, using MATLAB Simulink comparison of various performance characteristics is shown. The characteristics with and without VFD like speed waveform of stator, speed waveform of rotor, stator current response and rotor current response are studied. Energy conservation graph and torque waveform of with VFD and without VFD are compared using simulator.

Tamal Aditya [3] designed and simulated 3 HP, 4 Pole motor with inverter using PWM technique in MATLAB. Analysis of output waveforms of VFD viz., voltage, current, speed and torque waveforms was

discussed. Harmonic analysis was performed using FFT tool of powergui which resulted in decrease in Total Harmonic Distortion due to decrease in speed. The developed hardware is tested for 3 phase induction motor using PLC by Madivalappa and Aspalli [4]. Operations of various stages of VFD like rectifier, DC link, Inverter are described. The application of VFD for control solutions in ventilation section of Cement Industry is described by Amresh Kumar Ray et al [5]. VFD is used with induced fan to control the air flow in the kiln of Cement plant, to control speed of conveyor belt. Advantages of using VFD in mills to control the speed of production were discussed.

M.Deepa [6] designed a VFD for speed control of 3 Phase Induction motor for energy saving. Different control platforms like PWM V/Hz scalar control, PWM field-oriented control (FOC) or vector control, Direct torque control (DTC) were listed along with testing methods explained in brief. Three different optimization technique Conventional Optimization Techniques, AI Based Optimization Techniques and NIA Based Optimization Techniques used were discussed. Experimental setup of the circuit was done with components current transformer, induction motor, energy meter, timer, clamp meter, motor controller and operator interface. Comparison of result of energy consumption of motor with and without VFD was done showing low voltage and current consumption. Pooja Shinde et al. [7] have discussed the use of VFD in speed control of induction motor using microcontroller. Explanation of different stages of VFD such as rectifier stage, inverter stage and control stage was done in detail. Rectifier stage explained working of diode bridge rectifier. Inverter used here was Inverter Bridge using IGBT. Control stage included different control methods like constant ratio of voltage to frequency to control the output voltage. PWM technique is used to control inverter output. Microcontroller used for adjustment of output frequency by changing the switching time cycle.

### III. CONCLUSION

After studying various papers it is seen that V/F control technique is most commonly used than other control techniques. In this control technique the supply voltage (V) and frequency (F) is varied keeping V/F ratio constant. It is also seen that PWM technique is the only technique which is used to control the output of the inverter. Using VFD helps the motor to start softly. Motor energy consumption is reduced when VFD is used making it energy efficient. VFD reduces the switching losses and increases the operating speed making it motor operation more reliable.

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